

Original Research Paper

# Knowledge, Training Status and Willingness to Implement Cardiopulmonary Resuscitation of Medical University Students in Chongqing, China

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**Abstract:** Timely bystander Cardiopulmonary Resuscitation (CPR) is key to improving survival from out-of-hospital cardiac arrest. Medical university students are potential bystander CPR providers. This study aimed to identify the current level of CPR knowledge, the present status of training and factors affecting the willingness to perform CPR among medical university students in Chongqing, China. Random sampling method was used and a total of 1159 medical university students were included in this study. A self-administered structured questionnaire was used, which included: Demographic characteristics, basic CPR knowledge, CPR training experience, variables of the Theory of Planned Behavior and willingness to implement CPR. The data were analyzed using  $\chi^2$  test and multivariate logistic regression analysis. The respondents' mean CPR knowledge score was  $3.19 \pm 1.81$  (total of 6 points). Forty-eight point one percent of the respondents had received CPR training and 85.2% said they were willing to participate in CPR training. In case of cardiac arrest, 49.9% of respondents were willing to perform CPR. It was found that respondents with CPR training experience, high CPR knowledge level, high Subjective Norm (SN) scores, high Attitude towards the Behavior (AB) scores and high Perceived Behavioral Control (PBC) scores were more willing to perform CPR. It is necessary to incorporate CPR courses into medical universities' compulsory curriculum to increase the willingness to implement CPR.

**Keywords:** Cardiopulmonary Resuscitation, Medical University Students, The Theory of Planned Behavior, Training, Willingness

## Introduction

Out-of-Hospital Cardiac Arrest (OHCA) is a leading cause of mortality worldwide and is defined as the loss of functional cardiac mechanical activity and systemic circulation outside of a hospital (Myat *et al.*, 2018). More than 20,000 people die each year from OHCA in Canada (Vaillancourt *et al.*, 2013), 350,000 in the United States (Hansen *et al.*, 2015) and 544,000 in China (Chen *et al.*, 2017). Survival rates for OHCA are generally low worldwide, at around 7.9% in the United Kingdom (Hawkes *et al.*, 2017), 25% in Norway (Lindner *et al.*, 2011) and less than 1% in

China (Zhao *et al.*, 2013). The best time to resuscitate a cardiac arrest patient is within 4 min (Zhao *et al.*, 2013); however, it takes 5-8 min for the Emergency Medical Services (EMS) to arrive (Birkun and Kosova, 2018). Therefore, bystander Cardiopulmonary Resuscitation (CPR) before EMS arrival is critical for OHCA patients. A study in the United States (Fordyce *et al.*, 2017) found that OHCA patients who received bystander CPR in a public place had a significantly improved survival rate than those who did not, with an OR-value of 4.33.

Although bystander CPR effectively improves patient survival and quality of prognosis, the implementation rate is low. The global bystander CPR rate is

approximately 32% (Sasson *et al.*, 2010) and the average bystander CPR rate in 8 large and medium-sized cities in China is only 4.5% (Xu *et al.*, 2017), which is related to the low CPR training rate in China. Bystander CPR training in China started late and CPR training has not yet been incorporated into primary, secondary and higher education curricula (Hu *et al.*, 2019) and even medical universities have not made it a compulsory course for all students (Sun *et al.*, 2020); the prevalence of CPR training is less than 1% (Wang *et al.*, 2018), which is not commensurate with China's economic and social development. In 2019, the Chinese government launched the Health China Initiative (2019-2030) to encourage mass emergency rescue training and increase the proportion of people with training certificates to 1% and above and 3% and above by 2022 and 2030, respectively (Health China Initiative Promotion Committee, 2019). With their medical knowledge and medical literacy, medical university students are potentially a significant group of people who are highly likely to implement bystander CPR and spread CPR knowledge and skills and should be a priority training group in the public emergency ambulance training strategy.

However, having the knowledge and skills to perform CPR is not a sufficient condition to perform CPR. The Theory of Planned Behavior (TPB) believes that behavioral intention is the most direct factor that affects behavior and the best predictor of behavior. The 2010 American Heart Association guidelines (Field *et al.*, 2010) for cardiopulmonary resuscitation and emergency cardiovascular care were the first to place equal importance on improving bystander willingness to implement CPR and skill acquisition. Zhou *et al.* (2019) showed that even among Chinese medical personnel with some first aid skills, only 73.9% were willing to implement bystander CPR for strangers. The study results by Yaghmour and Movahed (2015) showed that only 40% of Iranian nurses were willing to implement bystander CPR that required artificial respiration. Studies have been conducted to analyze the factors that influence willingness to implement in terms of personal characteristics (Son *et al.*, 2017), level of CPR knowledge (Birkun and Kosova, 2018) and CPR training experience (Dobbie *et al.*, 2018). In addition to the above factors, according to the Theory of Planned Behavior (TPB), behavioral intentions are also influenced by Subjective Norm (SN), Attitude towards the Behavior (AB) and Perceived Behavioral Control (PBC) (Ajzen, 1991). The influence of significant others and prevailing social values on actors' implementation of CPR and the positive or negative attitudes actors hold towards implementing CPR may influence the willingness to implement CPR. TPB theory has been widely used to analyze health behaviors and behavioral intentions (Mentrikoski *et al.*, 2019; Shimazaki *et al.*, 2017; Boudreau and Godin, 2007). Therefore, we introduce TPB variables into the overall framework of the analysis

of factors influencing willingness to administer CPR to understand better the deeper psychological, motivational factors that prompt bystander CPR implementation.

While medical university students are potentially a significant group of people who are highly likely to perform bystander CPR, there is a relative lack of data on the level of CPR knowledge, the present status of training and willingness to perform CPR among medical university students in China, especially in the relatively economically disadvantaged western region of China. Therefore, this study was conducted to understand the level of CPR knowledge, the present status of training and implementation willingness of medical university students in Chongqing and the factors influencing the willingness to implement. The variables of TPB were introduced into the analysis of factors influencing willingness to implement CPR in order to identify the psychological motivations that may influence willingness to act and to develop theory-based interventions.

## Methods

### *Survey Setting and Data Collection*

This study was conducted in Chongqing, in western China. Chongqing is one of the four municipalities directly under the Chinese central government's jurisdiction, with an area of 82,400 km<sup>2</sup> and a population of 31.24 million and is known for its mountainous city. There are two physicians per 1,000 population and 3.1 nurses per 1,000 population, which are lack health resources. The government-sponsored 120 system provides Chongqing EMS. Due to the uneven distribution of emergency medical stations, traffic congestion and topography, it takes 20 min for EMS to reach the wealthiest urban areas and even longer in rural areas.

Chongqing Medical University is the only medical university in Chongqing that has been certified by the Chinese Ministry of Education to specialize in clinical medicine. It enrolls students from 31 provinces, autonomous regions and municipalities nationwide enroll students, of which 82.6% are from western China, with 25,367 full-time students, including clinical medicine, nursing, basic medicine, preventive medicine, pharmacy, medical laboratory, medical English, health service management and other medical-related majors.

Random sampling was carried out in students' dormitories. All dormitory buildings are selected and one dormitory is randomly selected from each floor. All students in the dormitory scan the QR code and fill in the electronic questionnaire. As of October 15, 2019, a total of 1210 questionnaires were collected. Fifty-one questionnaires were excluded due to incomplete and contradictory answers, yielding 1159 valid questionnaires with a 95.8% validity rate.

## Measurement

A five-part self-administered questionnaire was used for this survey:

- Part 1 included general demographic characteristics: gender, grade and major.
- Part 2 was CPR basic knowledge, including 6 questions with only one correct answer per question and correct answers counted for 1 point. Higher scores indicated a higher level of knowledge. Cronbach's alpha coefficient was 0.711.
- Part 3 consisted of content related to CPR training, including training experience, willingness to participate and barriers to CPR training participation.
- Part 4 measured TPB variables and included six questions on three dimensions: SN, AB and PBC. A 5-point Likert scale was used, with 1 indicating "strongly disagree/strongly unconfident/very few" and 5 indicating "strongly agree/strongly confident/majority", assigning a score of 1 to 5. Cronbach's alpha coefficient was 0.704.
- Part 5 is composed of CPR implementation's relevant content, including willingness to provide awareness check, respiratory examination and call 120, willingness to perform CPR and barriers to performing CPR.

## Data Analysis

All statistical analyses were computed using Statistical Package for the Social Sciences Version 26.0. (SPSS, Inc., Chicago, IL, USA). Continuous variables were expressed as means and standard deviations and categorical variables expressed as counts and composition ratios. The CPR knowledge score was calculated with a total score of 6 out of 6 questions, with scores of 0 to 3 considered low and 4 to 6 considered high.  $\chi^2$  test was used to compare differences in CPR training rates and differences in CPR knowledge level among students in different majors and grades and differences in barriers to CPR training participation and differences in barriers to CPR implementation among respondents who had and had not received CPR training. Multivariate logistic regression was used to explore factors influencing willingness to attend CPR training and willingness to perform CPR. All control variables were entered using the enter method. The level of  $p < 0.05$  was considered statistically significant in all tests.

## Results

### General Demographic Characteristics

Among the respondents, 451 (38.9%) were males, 708 (61.1%) were females. 448 (38.7%) were in the lower grades of undergraduate, 414 (35.7%) were in the

upper grades of undergraduate and 297 (25.6%) had a master's degree or above. There were 456 (39.3%) students in clinical and nursing majors and 703 (60.7%) in other medical-related majors.

### CPR Training Status

Of the respondents, 558 (48.1%) had received CPR training. 29.2% in the lower undergraduate years had received CPR training, with no difference between majors ( $p = 0.744$ ). Clinical and nursing training rates were significantly higher ( $p < 0.001$ ) in the upper grades of undergraduate majors, 57.5 percentage points higher than in their lower grades, while other medical-related majors were only 3.8 percentage points higher than in their lower grades. This gap has narrowed among respondents with a master's degree and above (Fig. 1).

An overwhelming majority (85.2%) of the respondents indicated their willingness to attend CPR training. Females (OR: 2.182; 95% CI: 1.555-3.063,  $p < 0.001$ ) and those with high CPR knowledge level (OR: 2.123; 95% CI: 1.370-3.292,  $p < 0.001$ ) were more willing to participate in CPR training. Barriers to attending or continuing CPR training included fear of a disconnect between theory and practice during training (52.5%), few opportunities for application (51.8%) and forgetfulness after learning (49.0%). Compared to respondents who had not received CPR training, more of those who had received CPR training cited few application opportunities and forgetfulness after learning as barriers to attending CPR training. Whereas 63.1% and 34.8% of respondents who had not received CPR training, respectively, cited difficulty accessing learning pathways and lack of time as barriers to attending CPR training, much higher than those who had attended the training (Table 1).

### CPR Knowledge

The respondents' mean CPR knowledge score was  $3.19 \pm 1.81$ , with an entirely correct knowledge rate (score of 6) of 13.4% and a high knowledge level rate (score of 4 and above) of 42.2%. The lowest accuracy rates were 41.0% and 44.1% for respiratory arrest judgment and the frequency and depth of CPR compressions, respectively (Table 2). The rate of CPR high knowledge level (scores of 4 and above) was less than 30% for all medical university students in the lower grades, with clinical and nursing majors slightly higher than students in other majors ( $p = 0.032$ ). The high knowledge level was 62.2 percentage points higher for clinical and nursing majors in the upper grades of undergraduate compared to the lower grades, but only 12.2 percentage points higher for other medical-related majors compared to the lower grades (Fig. 2).

### Measurement Results of Variables of TPB

Table 3 shows the results of each item in TPB. The mean score for AB was highest at  $4.06 \pm 0.78$  and the

mean score for PBC was the lowest at  $2.69 \pm 0.89$ . In PBC, only 15.0% of the respondents felt confident about implementing CPR (score of 4 or 5) and even among those who had received training in CPR, only 19.7% of the students surveyed felt confident about implementing CPR.

### Willingness and Barriers to Perform CPR

In cardiac arrest, 49.9% of respondents were willing to perform CPR and 81.7% said they would be willing to provide awareness check, respiratory examination and call 120. Respondents with CPR training experience, high CPR knowledge level, high SN scores, high AB scores and high PBC scores were more likely to

perform CPR. In addition to the non-significant PBC variables, these factors were also predictors of the willingness to provide awareness check, respiratory examination and call 120 (Table 4).

The main reasons for reluctance to perform CPR included: lack of confidence in one's ability to provide first aid (67.1%), fear of secondary harm to the injured person (58.4%) and fear of causing legal disputes (46.7%). Respondents with no CPR training were not confident in their ability to provide first aid (74.5%) and feared secondary harm to the injured (62.6%), while respondents with CPR training were more afraid of causing legal trouble (50.2%) and catching a disease (21.5%) (Table 5).

**Table 1:** Barriers to participation in CPR training

Barrier	Total, n (%)	Untrained, n (%)	Trained, n (%)	P-value
Fear of a disconnect between theory and practice during training	609(52.5)	316(52.6)	293(52.5)	0.981
Few opportunities for application	600(51.8)	275(45.8)	325(58.2)	0.000
Forgetfulness after learning	568(49.0)	272(45.3)	296(53.0)	0.008
Difficult access to learning pathways	564(48.7)	379(63.1)	185(33.2)	0.000
No time	333(28.7)	209(34.8)	124(22.2)	0.000
Lack of clarity on the importance of mastery	146(12.6)	78(13.0)	68(12.2)	0.685
Not interested	79(6.8)	45(7.5)	34(6.1)	0.347
Other	31(2.7)	9(1.5)	22(3.9)	0.010

CPR, cardiopulmonary resuscitation

**Table 2:** Correct rate of CPR knowledge

CPR knowledge	Total(n)	Percentage (%)
1. How to determine respiratory arrest	475	41.0
2. How to determine cardiac arrest	789	68.1
3. Ways of judging unconsciousness	586	50.6
4. Position of CPR compressions	770	66.4
5. Frequency and depth of CPR compressions	511	44.1
6. The correct sequence of CPR operations	562	48.5

CPR, cardiopulmonary resuscitation

**Table 3:** Items and score of TPB scale

Variable	Item	Title	$\bar{x} \pm s$
SN	sn1	Do you think your close family/ friends approve of you implementing CPR on strangers?	3.75±0.93
	sn2	How many people do you think would implement CPR on strangers?	3.04±1.02
	sn3	In an emergency situation, bystanders should offer what help they can.	4.11±0.83
AB	ab1	I would regret or be upset if someone else was disabled or killed because I failed to implement CPR in a timely manner.	3.95±0.98
	ab2	CPR is valuable and I would have a great sense of social value in implementing CPR to save others.	4.17±0.83
PBC	pbc1	How confident are you that others are implementing CPR?	2.69±0.89

TPB: The Theory of Planned Behavior; CPR, Cardiopulmonary Resuscitation; SN, Subjective Norm; AB, Attitude towards the Behavior; PBC, Perceived Behavioral Control

**Table 4:** Analysis of willingness to perform CPR

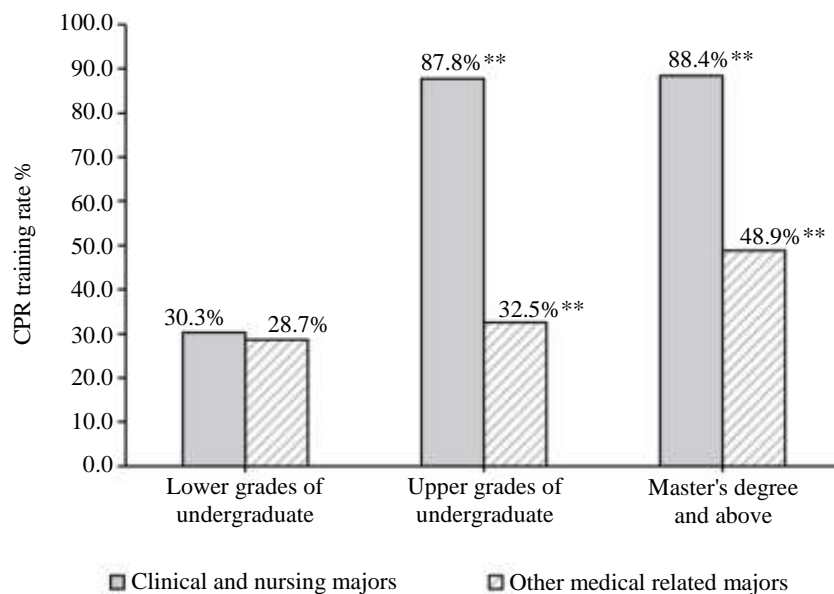
Variables	Willing to perform, n(%) / $\bar{x} \pm s$	OR(95%CI)	P-value
Gender			
Female	342(48.3)	1.00	
Male	236(52.3)	1.254(0.944-1.665)	0.118
Education			
Lower grades of undergraduate	184(41.1)	1.00	
Upper grades of undergraduate	229(55.3)	1.374(0.994-1.899)	0.054
Master's degree and above	165(55.6)	1.321(0.916-1.904)	0.136
Major			
Other medical-related majors	309(44.0)	1.00	
Clinical and nursing majors	269(59.0)	1.043(0.769-1.414)	0.788
Have you attended CPR training			
No	236(39.3)	1.00	
Yes	342(61.3)	1.607(1.185-2.178)	0.002
CPR knowledge			
Low level	278(41.5)	1.00	
High level	300(61.3)	1.513(1.090-2.100)	0.013
Subjective norm	3.88±0.64	2.235(1.757-2.843)	0.000
Attitude towards the behavior	4.28±0.66	1.703(1.384-2.096)	0.000
Perceived behavior control	2.98±0.88	1.883(1.588-2.234)	0.000

CPR, Cardiopulmonary Resuscitation

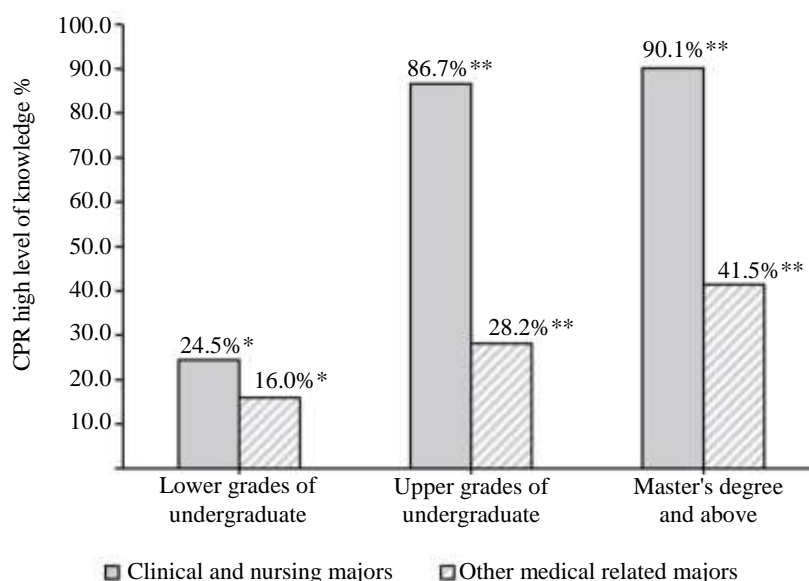
**Table 5:** Barriers to CPR implementation

Barrier	Total, n (%)	Untrained, n (%)	Trained, n (%)	P-value
Lack of confidence in your first aid abilities	778(67.1)	448(74.5)	330(59.1)	0.000
Fear of secondary harm to the injured	677(58.4)	376(62.6)	301(53.9)	0.003
Fear of legal disputes	541(46.7)	261(43.4)	280(50.2)	0.021
Fear of catching the disease	209(18.0)	89(14.8)	120(21.5)	0.003
Fear of public opinion	204(17.6)	115(19.1)	89(15.9)	0.155
Worried about being in danger during the treatment	149(12.9)	68(11.3)	81(14.5)	0.104
Fear of seeing injury or illness	87(7.5)	41(6.8)	46(8.2)	0.359
Other	22(1.9)	11(1.8)	11(2.0)	0.860

CPR, Cardiopulmonary Resuscitation



**Fig. 1:** Training rate of CPR across majors and grades. \*\* means P<0.001; CPR, cardiopulmonary resuscitation



**Fig. 2:** CPR knowledge level of CPR across majors and grades. \*means  $P < 0.05$ , \*\*means  $P < 0.001$ ; CPR, cardiopulmonary resuscitation

## Discussion

In our research, the respondents' CPR knowledge's mean score was  $3.19 \pm 1.81$  (total score of 6) and less than 50% scored high (greater than or equal to 4). It was indicating that the respondents' knowledge of CPR was inadequate. Similar knowledge deficiencies were found among medical students in other developing countries, Jordan (Oteir *et al.*, 2019), India (Aroor *et al.*, 2014), Egypt (Mohammed *et al.*, 2020). Lack of continuous and formal training may be the main reason for the lack of CPR knowledge among medical students in developing countries. Our findings show that the average CPR knowledge score for those who had not attended the training was only 2.33, significantly lower than those who had attended the training (4.10). However, only 48.1% of those surveyed had attended training, far below the general public's training rates in developed countries such as the United States (Anderson *et al.*, 2014) and Norway (Bakke *et al.*, 2016). Only 29.2% of respondents in the lower undergraduate grades had participated in the training and the training rate for non-clinical and nursing students in the upper undergraduate grades was only 3.8 percentage points higher than in the lower grades. This suggests a lack of training opportunities for non-clinical and nursing students at the university level, even in medical universities and that the training they receive is more likely to come from the school or community activities near their home they attended in secondary school (Pan and Zhang, 2017). The lack of training opportunities is also illustrated by the fact that 63.1% of respondents with no training experience reported that difficulty accessing learning pathways was the most

significant barrier to their CPR training participation. Despite this, over 85% of respondents expressed their desire to attend training.

The results of this survey show that 49.9% of the respondents were willing to perform CPR, which is similar to the findings of another Chinese municipality, Tianjin (45.3%) (Lu *et al.*, 2016) and Malaysia (51.4%) (Chew and Yazid, 2008) for medical students, but lower than the findings of Italy (75%) (Contri *et al.*, 2017). Training experience and level of knowledge are important influences on willingness to implement CPR. The analysis showed that those with training and high knowledge were 1.607 and 1.513 times more willing to implement CPR than those with no training and insufficient knowledge, respectively, similar to the study of Son *et al.* (2017) and Dobbie *et al.* (2018).

Also, TPB variables, including AB, SN and PBC, positively affected respondents' willingness to implement CPR. AB scored the highest of the three variables, at  $4.06 \pm 0.78$ , indicating that medical university students generally recognize the value of implementing CPR and have a high sense of social responsibility. PBC scores were the lowest, with a mean score of only 2.69. Respondents generally lacked confidence in implementing CPR, with 67.1% citing lack of confidence as a barrier to implementing CPR. On the one hand, it is related to the lack of training and the low level of CPR knowledge of the respondents. On the other hand, it may be related to the poor practicality of the training courses (Huang *et al.*, 2020), the lack of retraining (Yang *et al.*, 2019) and the lack of confidence-boosting training content (Huang *et al.*, 2016). The survey results also showed that 59.1% of those who had

taken part in the training were not confident in their first aid skills and more than half of them expressed concern about the disconnect between theory and practice during the training and forgetfulness after learning. The positive effect of SN on medical university students' willingness to give help was most significant. The item "In an emergency situation, bystanders should offer what help they can" scored the highest, which is in line with the traditional Chinese virtue of being brave and willing to help others (Xue, 2017), as well as the core spirit of the Hippocratic Oath of medical students to save lives and help the sick for the benefit of patients. The other two items scored relatively low, with medical university students believing that those around them may not be very supportive of performing CPR for strangers and that relatively few people perform CPR in reality. This may be related to their perceived barriers to implementing CPR. In addition to the lack of confidence in first aid capabilities, fear of legal disputes was the most critical barrier factor to implementing CPR as perceived by the respondents. The survey results show that 46.7% of respondents are concerned about legal disputes arising from the implementation of bystander CPR, unlike the findings in Denmark (Malta Hansen *et al.*, 2017) and Scotland (Dobbie *et al.*, 2018) (8%). In China, it was not until 2017 that the "good man law" provisions were written into the General Principles of the Civil Law. The late introduction of the relevant exemption provisions leads to its insufficient social influence up until now, and it is still the provisions' principle which means there are no comprehensive and systematic details of the provisions of the exemptions for strangers to perform first aid. Thus the feasibility is relatively not high. Besides, during the legal gap, the case of "saving a person from being blackmailed" (Fu, 2012) was misinterpreted and overly fermented in the online media, which brought negative social impact and increased people's concern about possible legal disputes. Based on this, medical university students may tend to believe that although they should help in terms of mainstream values, loved ones and friends may be less supportive of implementing CPR for their protection and fear of getting into trouble and relatively few people in reality implement CPR.

More respondents (81.7%) were willing to provide consciousness and respiratory checks and call emergency services for patients than to perform CPR, which maybe related to the respondents' perception that the above measures are simpler and generally have a higher level of self-confidence. This suggests to us that the vast majority of medical university students are willing to lend a helping hand when faced with a patient in potential cardiac arrest, but may be afraid to perform CPR given their lack of training and confidence, fear of secondary harm to the patient and legal disputes.

In summary, we recommend that the government develop training plans to incorporate CPR training and retraining into primary, secondary and higher education curricula in a planned manner. In particular, it should be made a mandatory course for all students in medical universities. Relevant institutions and researchers should develop online and offline training courses according to the population's characteristics and focus on adding confidence-boosting training content to the training curriculum; standardize the assessment process and standards and issue qualification certificates with certain validity for those who pass the exam. The legislature should expedite the introduction of more detailed and operational legal provisions for public first aid exemptions to protect rescuers' rights and interests. Emergency medical rescue dispatch agencies can instruct bystanders on the implementation of CPR via APP video or telephone to enhance rescuers' confidence.

## Limitation

Our study has several limitations. First, this study was a cross-sectional investigation and it was not possible to determine the exact causal relationship between the variables. Second, this study was only conducted on medical university students in Chongqing, which has a particular regional dimension and may limit the study findings' generalization. Third, the respondents' willingness to perform CPR does not mean that they would perform CPR in a real situation and future studies should focus on the actual behavior of performing CPR. Finally, this study used the Theory of Planned Behavior as a framework to identify some of the influences on bystanders' willingness to implement CPR and future research could also focus on actual powerful analytical framework models, such as the Integrated Behavior Model (IBM), to more fully explore the influences on implementing CPR.

## Conclusion

The level of CPR knowledge of Chongqing medical university students was poor and they had a positive attitude towards CPR training, but the percentage of those who had received CPR training was not high. About half of the students surveyed were willing to implement bystander CPR and AB, SN and PBC positively impacted. Lack of confidence in one's ability and fear of legal disputes are the most significant barriers to implementing bystander CPR. Intensive training and improved legislation are recommended to increase willingness to implement CPR.

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## Authors Contributions

**Yan Zhang:** Conceptualization, Methodology, Writing-Reviewing and Editing, Project Administration.

**Huixian Zhou:** Methodology, Investigation, Data analysis, Writing-Original Draft.

**Chuan Pu, Feng Chen and Dianguo Xing:** Methodology, Supervision, Feedback.

**Jiani Mao and Ling Jia:** Investigation, Data Curation, Feedback.

## Ethics Approval

This study was approved by the Ethics Committee of Chongqing Medical University (Date Approved: October 8, 2019).

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## Abbreviations

- CPR: Cardiopulmonary Resuscitation  
OHCA: Out-of-Hospital Cardiac Arrest  
EMS: Emergency Medical Services  
TPB: The Theory of Planned Behavior  
SN: Subjective Norm  
AB: Attitude towards the Behavior  
PBC: Perceived Behavioral Control